



# Forestry Department

Food and Agriculture Organization of the United Nations

## Fire Management Working Papers

### Global Forest Resources Assessment 2005 – Report on fires in the Sub-Saharan Africa (SSA) Region

*by*  
Alexander Held

March 2006

## Disclaimer

The Fire Management Working Papers report on issues addressed in the work programme of FAO. These working papers do not reflect any official position of FAO. Please refer to the FAO website ([www.fao.org/forestry](http://www.fao.org/forestry)) for official information.

The purpose of these papers is to provide early information on on-going activities and programmes, and to stimulate discussion.

Comments and feedback are welcome.

For further information please contact:

Mr. Petteri Vuorinen, Forestry Officer (Forest Fire Management)

Mr. Peter Holmgren, Chief

Forest Resources Development Service

Forest Resources Division, Forestry Department

FAO

Viale delle Terme di Caracalla

I-00100 Rome, Italy

e-mail: [petteri.vuorinen@fao.org](mailto:petteri.vuorinen@fao.org)

[peter.holmgren@fao.org](mailto:peter.holmgren@fao.org)

or: FAO Publications and Information Coordinator:

[andrea.perlis@fao.org](mailto:andrea.perlis@fao.org)

For quotation:

FAO (2006). Global Forest Resources Assessment 2005 – Report on fires in the Sub-Saharan Africa Region. Fire Management Working Paper 9. [www.fao.org/forestry/site/fire-alerts/en](http://www.fao.org/forestry/site/fire-alerts/en)

## FOREWORD

Fires impact upon livelihoods, ecosystems and landscapes. Despite incomplete and inconsistent data, it is estimated that 350 million hectares burn each year; however, the nature of fires determines whether their social, cultural, environmental and economic impacts are negative or positive. Up to 90 percent of wildland fires are caused by human activities primarily through uncontrolled use of fire for clearing forest and woodland for agriculture, maintaining grasslands for livestock management, extraction of non-wood forest products, industrial development, resettlement, hunting and arson - thus any proactive fire management needs to adopt integrated, inter-sectoral, multi-stakeholder and holistic approaches. The situation varies markedly in different regions of the world.

As a supplement and complement to the Global Forest Resources Assessment, 2005, this working paper is one of a series of twelve prepared by regional and country contributing authors to provide a greater depth of data and information on fire incidence, impact, and management issues relating to the twelve UN-ISDR Regional Wildland Fire Networks around the world.

The working paper series assesses the fire situation in each wildland fire region, including the area extent, number and types of fires and their causes. The positive and negative social, economic and environmental impacts are outlined. Prediction, preparedness and prevention as key elements in reduction of the negative impacts of fire, rapid response to extinguish fire incidents and restoration following fires are addressed.

The working paper series also addresses institutional capacity and capability in wildland fire management, including the roles and responsibilities of different stakeholder groups for prevention and suppression, particularly the unique role of community-based fire management.

From these working papers, a FAO Forestry Paper on Fire Management will synthesize the highlights from each region, but also provide a global summary of important lessons that can be used in fire management in the future. These papers are a valuable resource in the process to prepare the Fire Management Code, the Global Strategy to Enhance International Cooperation in Implementing the Fire Management Code and associated capacity building.

## **ACKNOWLEDGEMENTS**

This working paper is the product of a global team of dedicated people willingly giving of their time and specialist expertise within each of the twelve UN-ISDR Regional Wildland Fire Networks.

Alexander Held, as the author, obtained key information and data for this working paper from Angola, Botswana, Burkina Faso, Burundi, Cameroon, Central African Republic, Chad, Congo, Democratic Republic of Congo, Equatorial Guinea, Ethiopia, Gabon, Ghana, Mozambique, Namibia, Rwanda, Sao Tome and Principe, South Africa, Sudan, Tanzania, Zambia and Zimbabwe.

We wish to acknowledge the dedicated work of Johann G. Goldammer, Global Fire Monitoring Center (GFMC), for contributing materials and for reviewing this working paper.

We also wish to thank Michèle Millanès for the excellent editing and formatting undertaken.

To all persons who contributed to this working paper, we express our grateful thanks.

## TABLE OF CONTENTS

<b>1. BACKGROUND.....</b>	<b>1</b>
<b>2. FIRE SITUATION IN THE SSA REGION.....</b>	<b>1</b>
2.1 <i>Fires in a historical perspective.....</i>	<i>1</i>
2.2 <i>Extent and types of fire.....</i>	<i>1</i>
2.3 <i>Reasons.....</i>	<i>3</i>
2.3 <i>Damages.....</i>	<i>5</i>
2.4 <i>Fire prevention.....</i>	<i>7</i>
2.5 <i>Fire suppression.....</i>	<i>9</i>
<b>3. STAKEHOLDERS / ACTORS.....</b>	<b>9</b>
3.1 <i>Responsibilities and roles.....</i>	<i>9</i>
3.2 <i>Collaboration.....</i>	<i>10</i>
3.3 <i>Community involvement.....</i>	<i>14</i>
3.4 <i>Needs and limitations.....</i>	<i>15</i>
<b>4. ANALYSIS AND RECOMMENDATIONS.....</b>	<b>15</b>
<b>REFERENCES.....</b>	<b>17</b>
<b>ANNEX 1.....</b>	<b>19</b>
<b>ANNEX 2.....</b>	<b>22</b>

## **1. Background**

Following the release of the Global Forest Resources Assessment 2000 (FRA 2000) report in 2001, the global FRA process has now entered its next reporting cycle. FAO's Committee on Forestry (COFO) 2003 confirmed the directions of global FRA's that the Kotka IV Expert Consultation recommended in July 2002. Recommendations included the preparation of an update of the global FRA-data in year 2005 and to increasingly involve countries directly in the assessment and reporting, in particular to submit national reports on the status and trends of a range of forestry parameters. More information about FRA 2005 is available at [www.fao.org/forestry/fra](http://www.fao.org/forestry/fra).

FRA 2005 also included thematic studies, including e.g. one on forest fire, forests and water, and mangroves. The thematic study on wildland and forest fire in 2005 is built on regional reviews on forest fire management in the UN International Strategy for Disaster Reduction (UNISDR) Global Wildland Fire Networks (GWFN) The current report is a contribution and makes a review of the ISDR Sub-Saharan Africa (SSA) Region.

This Working Paper FM/9/E has been written by Mr Alexander Held and does not reflect any official position of FAO.

## **2. Fire Situation in the SSA Region**

### ***2.1 Fires in a historical perspective***

Historically, the use of fire in Southern Africa was controlled by the Traditional Authorities (TA) who restricted the use of fire to certain planned occasions and events, such as hunting. The use of fire by local people required permission from the TA.

However, during colonial times new fire legislation and no-burn policies were introduced, starting from the end of the 17<sup>th</sup> century. These policies and practices were modelled on those e.g. in Europe. Local practices and, consequently, earlier control mechanisms, were revoked or became invalid.

While the TAs were stripped of authority to control fires, local people soon realized that the colonial officers implementing the fire bans were seldom present due to the remoteness of many areas. Because of lack of supervision, fire was increasingly frequently used by the local population at the beginning of last century. The use of prescribed burning was forgotten and local people started to believe that the indiscriminate use of fire was a part of the inherited traditions. By 1970, almost all forest and woodlands in southern Africa were fully or partially burned every year, due to such indiscriminate and widespread use of fire, coupled with rapid increases in human populations.

### ***2.2 Extent and types of fire***

In all major publications about vegetation fires in Sub-Saharan Africa, the African continent is referred to as the "Fire Continent". Africa sparkles with more routine fire than any other landmass (Pyne, 2004).

In Africa, south of the Sahara desert, more vegetation fires burn and in higher frequencies than on any other continent. One has to admit that the quality of statistical fire data from SSA is poor. This is due to, among others, political reasons, technical and resource problems and the fact that statistics have never been the key issues in fire management in Africa. The attentive reader will recognize the sometimes huge discrepancies between satellite-derived data and data collected on the ground, as well as discrepancies within the different satellite systems. Collection of reliable ground data is not achievable in the vast territories of the African continent. The nature and numbers of African fires presently do not allow countries to accurately register the annually burned area, a few countries excluded. Remote sensing is today the only way to collect statistical fire data like e.g. the extent of burned area.

A review of the most recent satellite-derived assessments of the land area affected by fire in Africa has been provided by an FAO study prepared for the 24<sup>th</sup> FAO Regional Conference for Africa (Bamako, Mali, 30 January - 3 February 2006) which is quoted in the following (FAO, 2006):

“The advent of satellite-based remote sensors which can detect active fires and recent fire scars has rapidly advanced our understanding of the extent and seasonal occurrence of burning. Each sensor differs in its technical specifications, capabilities and applications, and the more widely used include NOAA-AVHRR, ERS-ATSR, SPOT-Vegetation, MODIS, Meteosat, and Landsat-ETM and MSS. Up to now, most of the work has been experimental but a number of operational systems are emerging. Initial work focused on detecting active fires. Whereas these show the spatial location and season of burning, they do not accurately reflect how much area is burned. More recently, therefore, attention has focused on detecting and mapping the extent of burned areas.

The first global survey of burned areas was carried out by the Joint Research Centre of the European Commission (JRC-EU). This study, based on the detection of fire scars from the SPOT-VEGETATION sensor for 2000, showed that Africa is the most fire-prone continent in the world. An estimated 2.3 million km<sup>2</sup> or 7.7 percent of the continent burned in 2000, which is 64 percent of the global total of just over 3.5 million km<sup>2</sup> (JRC-EU, 2005).

In terms of the number of fires, as indexed by the number of fire scars, Africa, with 54 percent, also leads the world. For 2004, the MODIS sensors on NASA’s Terra and Aqua satellites detected active fires in 2.3 million 1 km<sup>2</sup> pixels, equivalent to 7.8 percent of Africa’s land area, a similar extent of burning to that in 2000.

Although these data come from only a couple of years of observation, they are broadly consistent with other studies done earlier at a coarser scale over a number of years or covering only part of the continent (Barbosa *et al.*, 1999; Silva *et al.*, 2003). The exception is the European Space Agency’s GLOBSCAR product, which suggests that only 1.2 million km<sup>2</sup> was burned in 2000 (Hoelzemann *et al.*, 2004).

Burning in 2000 was most extensive in East Africa (873 840 km<sup>2</sup> or 15.0 percent of the area), Central Africa (539 225 km<sup>2</sup>, 13.5 percent) and southern Africa (677 123 km<sup>2</sup>, 11.5 percent).”

For this regional report the magnitude of vegetated area regularly affected by fire has been derived from various sources and is compiled in Annex I, Table 1. The extent of burning in those thirteen African countries in which more than 10 percent of the land area was burned in the year 2000 is provided in Annex I, Table 2.

To further complicate the issue about collection of reliable fire data, one has to remember that most ecosystems of SSA, during more than one million years, have evolved through the human use of fire. Consequently therefore, these ecosystems need fire to be maintained (including biodiversity) and remain healthy. Too much fire, or the wrong kind of fire, is as detrimental as lack of fire for maintaining these ecosystems, especially around the basins of Sahara, Kalahari or Namib.

On the other side, too frequent fires may destroy the ecosystems, and repeated burns gradually kill the trees and expose the soils. Subsequently water and wind erosion degrade the former forest land into a desert.

The climatic conditions of the overwhelming part of Sub-Saharan Africa have a distinctive wet and dry season which together favour regular occurrence of wildland fires. The wet season is encouraging fuels to grow (the wetter the more) and the dry season with high temperatures and low humidity, provide inductive burning conditions, dried out vegetation and a long fire season. However, in drought conditions we can either have an increased fire danger due to extreme fire weather conditions, or a decrease in fire danger as there is not enough fuel to sustain a fire. In addition, every few years the *El Niño* weather pattern provides climatic conditions which favour extended wildfire episodes.

Most fires, wanted and unwanted, occur in the savanna biome, followed by burning for agriculture in a slash-and-burn mode, or burning of agricultural residues. Large-scale burning of slash after forest harvesting is also a common practice in the forestry plantations of southern Africa. In addition, cooking and heating fires fuelled by wood, charcoal or agricultural residues, are the main source of domestic energy in SSA.

Fire in the savanna ecosystems is a necessary disturbance which influences vegetation structure, composition, nutrient recycling and distribution and therefore, fires which burn in the natural fire cycle are stabilizing the savanna ecosystems. However, there is hardly a site found where fires burn in their natural way (with right intensity and timing); they either occur too frequently and result in degraded soils, or occur too seldom, creating massive accumulations of fuel and intense fires. Over the recent years, extended areas of southern African savanna ecosystems have been changed by a phenomenon called "bush encroachment"; where this occurs, the land loses its grass sward and therefore totally changes the characteristics of the biome. This phenomenon cannot be generalized, but has to be observed and dealt with in time because often bush encroachment is related to long periods of fire exclusion.

Experiences from e.g. central Namibia tell that it may require tens of years to restore the original savanna ecosystem by careful re-introduction of fire.

The slash-and-burn method is widely used in African agriculture; for clearing agricultural sites or removing agricultural residues. More often, these planned fires are left unattended, and spread into neighbouring lands and end up as unwanted wildfires or become forest fires.

In forestry plantations, large-scale prescribed burning is a standard activity (primary in the Republic of South Africa) to prepare sites for planting after harvesting. Fire breaks around and in the compartments are also prepared through burning. More than 10% of all plantation fires originate from these activities, due to a lack of training of the personnel (Goldammer and de Ronde, 2004). In the newly established plantations in Mozambique, this percentage may even be higher.

## **2.3 Reasons**

### **Natural fire causes**

Lightning is a natural weather phenomenon in Africa and can be an ignition source like e.g. in western Namibia where 60% of all fires stem from so called electrical storms. Although these electrical storms carry no rain, they are very dangerous for the fire fighters, due to the high winds

Wildlife can also start fires, i.e. baboons rolling down rocks, which create sparks. However, the major portion of fires in Africa is started by human beings. Considering the fact that fire and early humans played an important role in Africa for hundreds of thousands years in shaping the environment, one could come to the conclusion that man, as an ignition source, is also in a way a natural fire cause in Africa. Here anthropogenic fire originated and has resided longer than anywhere else (Pyne, 2004).

### **Prescribed burning**

Under controlled burning we can list all agricultural fires in general, be it subsistence farming with slash-and-burn practices in the rural Africa or commercial farming operations. The commercial cattle farmers mainly burn for pasture management to remove moribund unpalatable grass sward. It is sometimes annoying how little fire management knowledge is to be found among the commercial farmers of southern Africa. Therefore there is an urgent need to educate the commercial farming community in the 'dos and don'ts' to ensure the positive use of fire for increased forage productivity. The ignorance as well as lack of skills in using fire is causing major problems in the long run; soil degradation and a significant loss in livestock productivity are the results of bad fire management, not to forget the creation of favourable conditions for bush encroachment.

Besides in livestock production and in sugar cane farming, fire is not widely used in commercial farming areas. The land use change to more organized agriculture will change the use of fire in the landscape. However, there are also backward trends towards increased subsistence farming in support of the growing population in some areas of Sub-Saharan Africa, Zimbabwe being a prominent example.

In the traditional African societies, the use of fire was well regulated and fire was wisely used. Local communities and their traditional leaders had a sound knowledge and experience in the use of fire as a land management tool, based on thousands of years of experience. Unfortunately these traditional fire management systems were initially disrupted by the colonial masters and later almost eradicated because of new ideological and political approaches. Today, the traditional leaders have no role to play in fire management in the majority of the rural Africa. However, this scenario may soon change when countries have to decide what role they are going to assign to traditional leaders when developing enabling framework for large-scale community-based fire management (CBFiM) activities. The traditional leadership in Burkina Faso, Mozambique and Namibia, with its intimate local knowledge, has proven to be a great asset to government agencies, responsible for fire management. Unfortunately there are numerous complicated reasons why efficient local fire management, headed by traditional leaders, is difficult to re-introduce. To list just a few causes: migration, rural exodus, poverty, civil unrest, wars, epidemics like HIV, break up of the traditional systems due to other political approaches, etc.

Prescribed burning is one of the few viable management tools in nature conservation and wildlife management in fire-adapted ecosystems. Most of the great National Parks and Nature Conservation areas, e.g. in the Southern African Development Community (SADC) region, and in its neighbouring countries, have fire management plans in place, sometimes as basic as a “let burn” policy, depending on available resources. Fire in these areas is used according to ecological indicators and based on long-term scientific research and local experience.

In southern Africa, more and more commercial farmers turn their lands into game management areas, as there is more profit in tourism, than in commercial farming. These game farms, as they are “re-naturalized”, need fire to maintain and shape the ecosystem in combination with the impact of grazing and browsing game. In most of the management plans for these game and nature reserves, the use of fire is missing completely. Appropriate standards for fire safety and fire behaviour knowledge for farm managers are missing.

In preparation of prescribed burning, fire breaks can be cleared mechanically or by overgrazing critical strips, but breaks are also often burned to clear them from burnable vegetation. Many thousands of kilometres of fire breaks are burned in southern Africa annually.

### **Negligence/lack of training**

Negligence is the most common fire cause throughout Africa. Be it honey hunters, poachers, abandoned camp fires, cooking or warming fires, playing kids or escaped prescribed fire, the list is long and one can think of many examples where negligence is causing wildfires.

But negligence is not a God-given fact and can be addressed quite effectively, as some examples from fire management projects throughout the African continent keep on proving. The challenge is in how to create an enabling environment and empowerment of the population affected by uncontrolled and unwanted destructive fires. The local population needs to be educated to understand that unwanted fires cause damage; and importantly, to be told how much the community loses in these fires, as well as to be aware that the wise use of controlled fires creates benefits for the community.

### **Arson**

The reason for starting a wildfire on purpose and accepting the potential damage from that fire are diverse. Arson is done out of cultural or religious beliefs, wrong understanding of an “African burning tradition”, civil unrest and personal anger, fear (burning the bush to open it up). Arson fire is also commonly lit by low-ranking community members to feel empowered or thrilled. The government fire service is often at loss when trying to identify the local arsonist; however,

traditional and local leaders often know personally the pyromaniacs and can easily monitor their moments.

Especially the pyromaniacs in the rural Africa should primarily be tried locally by the traditional leaders applying local bylaws; and the fine should be set according to damage caused by the fire. Burned crops and housing could cause a fine of for example two heads of cattle. Bringing the culprit to the police and putting the arsonist in jail would not solve the fire problem; on the contrary, the arsonist would often leave behind a starving family which then would need to be supported by the community.

One of the underlying causes of frequent arson is the problem of “ownership” or tenure. Very often when the land belongs to the state or to an anonymous company and most of the profits never reach the local population, this situation creates a widespread lack of a responsibility for the sustainable use of natural resources and the environment.

### **2.3 Damages**

Although estimates of the total economic damage of African fires are not available, ecologically and economically important resources are being increasingly destroyed by fires crossing borders from a fire-adapted to a fire-sensitive environment (Goldammer and de Ronde, 2004).

While the natural ecological role of fire must be recognized, the exposure of communities, agriculture business and infrastructure to large, devastating fires in the recent past, shows the vulnerability and damage potential of uncontrolled fire (Heine, 2002).

Substantial uncontrolled fires occur across Africa and affect life, property and fire-sensitive natural resources. Secondary effects are the current burden of emissions on the atmosphere with subsequent adverse effects on the global climate system and human health. Major problems arise at the interface between fire savannas, residential areas, agricultural systems and those forests which are not adapted to fire. Fire as an effective and affordable tool is also contributing to widespread deforestation in many southern African countries.

The impact of wild fires in natural vegetation on the poorest of the poor, particularly the rural poor, cannot be overstated. Those people living at the margins of daily survival are always the most vulnerable. In the case of rural settlements (and also in the case of some of the urban settlements), located physically at the margins of sustainable livelihoods, in the transition zone between densely settled land and lands carrying high fuel loads are the most vulnerable. Whether these fuel loads are the result of natural development or the lack of integrated fire management (including fuel reduction strategies) in the natural environment, the consequences are the same. These areas form high fire risk zones, and the inhabitants of the adjacent settlements bear the brunt of such unmanaged risk. The direct losses are in terms of:

- loss of life, disability and increased respiratory sicknesses, due to vegetation fires;
- loss of housing and possessions when thatched or wooden dwellings ignite;
- loss of grazing, crops, livestock and subsistence natural resources;
- negative effect on tourism;
- reduced quality of water; and
- soil erosion by water and wind.

Of equal – if not greater – importance is the “knock-on” effect of wildfires on rural economies. An example from South Africa (Anonymous, 2004):

“A survey of flower and thatch harvesting of natural plant resources (e.g. wild flowers) in the fynbos ecosystem in 1993 showed that the value of this produce amounted to R65-70 million per year and sustained 20-30 000 rural people in subsistence livelihoods. While no accurate current value is available, it is estimated that the value of this industry is now amounting to at least R120 million per year, sustaining an equal number of jobs.

The extensive fire in early 1998 in the Plettenberg Bay area provides a poignant illustration of the impacts of such fires on the poor. Five employees of the *Working for Water*, a South African environment programme and a sixth person lost their lives, and a further nine were seriously injured. In the Craggs Municipality area alone, as a result of the loss of forestry and natural veld resources, 150 jobs were lost in the plantation/saw milling and flower harvesting sectors. While these jobs may not all be lost permanently, there will be a hiatus of four to five years before the veld is old enough for flower harvesting. The extent to which jobs in the timber industry will be recovered is questionable. In a small rural community where the alternatives for economic activity are limited, a fire of such magnitude has devastating social consequences”.

The situation described above can be applied to just any other African country, just changing the fynbos to thatching grass for instance, which is used for thatching roofs and provides an important income for the rural population, e.g. in Botswana and Namibia. Quite often, although not reported in the media, fires not only destroy the vegetation around the rural settlements, but also the houses themselves, leaving the population without shelter and income.

The ecological long-term consequences of too frequent uncontrolled fires in African ecosystems are described profoundly in the literature. In general terms, unwanted fires change the species composition, vegetation structure and composition, soil properties are degraded and the soil productivity, both commercial and natural, decreases as a result. In some biomes the frequency of wildfires is alarming and widespread, such as in the forests and savannas of West and East African countries (Pyne, 2004).

However, the opposite phenomenon of too little fire also occurs in southern Africa, which can also be categorized as damage to the ecosystems, especially in the tropical and sub-tropical savannas. In areas where “European” fire suppression was successful, a massive bush encroachment can be observed, changing the typical savanna characteristics. A prime example of that is found in the *Lowveld* region in Mpumalanga, South Africa and Central Namibia. Obviously bush encroachment is not only a result of too little burning, climatic factors as well as the cattle itself may also contribute significantly to the encroachment process, but the dysfunctional fire regime plays a key role in the process of ecological change.

The occurrence of uncontrolled wildfires has a negative influence on the tourism industry of SSA because a burned landscape looks unappealing to the tourist's eye. Tourists may also feel insecure if fires are raging and destroying the environment during their visit.

When talking about social, economic and ecological damages, it becomes clear that one has to look carefully at all levels and all aspects of fire management in Africa. The question is not of how to suppress and avoid fires, but how to manage to use fire in a sustainable and responsible way to the benefit of the African environment and its people. How then empower and enable the affected population to apply integrated fire management for their own benefit; but often on the behalf of the land owner Back in the 1960s, Phillips (1965) formed the famous saying that fire is “*a bad master but a good servant*”.

### **Impacts of wildland fire emissions on the atmosphere**

The recent FAO report prepared for the 24<sup>th</sup> FAO Regional Conference for Africa (FAO, 2006) provides a statement which suitably summarizes the main impacts of vegetation fires in Africa on the atmosphere and notably on the global carbon cycle:

“Fires emit a range of chemical compounds in both gaseous and aerosol form. The nature of these emissions from any one fire depends on the types of fuels present and on the ratio of the flaming to smouldering phases of combustion.

Extensive research has been carried out in Africa over the past 15 years on emission of aerosols and trace gases from most kinds of fires, though more information is needed on emissions from agricultural fires and charcoal use. Research, most notably in southern Africa during the SAFARI-92 and SAFARI 2000 research campaigns, and in Central and

West Africa as part of DECAFE and EXPRESSO, has produced good estimates of emission factors for many of the important greenhouse gases, chemical precursors and fine particulate matter (<2.5 µm diameter) from different types of fires and fuels. While there is some uncertainty at the level of fine detail, the broad picture is clear: biomass burning in Africa is a major source of emissions to the global atmosphere.

The current estimates of the quantity of biomass burned globally each year from all sources are about 9 200 million metric tonnes (million mt). Overall, global wildfires consume 5 130 million mt, 42 percent of which is burned in Africa (including fires associated with deforestation). These fires in Africa release about 3 431 million mt of CO<sub>2</sub>, as well as significant quantities of other emissions.

**Table 1.** Emissions (in million metric tonnes) to the global atmosphere from African forest and savanna fires, compared with global figures.

	<b>African savanna</b>	<b>African forest</b>	<b>African total</b>	<b>Global wildfires</b>	<b>African fires as % of global</b>
Biomass burned	2000	130	2130	5130	41.5
Carbon dioxide	3226	205	3431	8201	41.8
Carbon monoxide	130	14	144	413	34.9
Methane	4.6	0.9	5.5	19.4	28.4
Nitrogen oxides	7.8	0.2	8.0	16.3	49.1
Total particulate matter	16.6	0.8	17.4	48.8	35.7

Source : Data from Andreae (1997, 2004) with modification

These compounds can be transported long distances in the atmosphere, during which time some are transformed by various chemical and physical processes catalyzed by ultraviolet radiation. Carbon monoxide, methane and nitric oxide are important precursors in the atmospheric photochemical oxidant cycle. This governs the concentration of the hydroxyl radical (OH), the main oxidant responsible for removing many of the pollutants released into the atmosphere, as well as tropospheric ozone, which is toxic to both people and plants. Fires in Africa are thought to be the main cause of the plume of tropospheric ozone that extends across the Atlantic Ocean from Africa to South America annually during September-October.”

## **2.4 Fire prevention**

Fire prevention in sub-Saharan Africa can be debated. Most African countries have established a national fire prevention programme. However, the implementation on the ground of a fire prevention programme is a different story. Countries like Botswana, Namibia and South Africa have a quite extensive network of fire breaks prepared annually. These fire breaks mainly follow property boundaries, with the aim to protect a specific site or area. A study conducted in South Africa showed the advantages of establishing so called “Regional Buffer Zones”, i.e. where natural fire breaks like rivers etc., are incorporated in the fire break system, to protect a whole region, and not only patches of a region. This approach would need the willing cooperation of all role players and stakeholders within a region, and is quite difficult to obtain. The first positive results of zoning can be observed in regions of South Africa where so called Fire Protection Associations (FPA) are formed and where the fire protection and prevention is covering a whole region, including all landowners, authorities, traditional leaders and their communities, etc.

Botswana is preparing 12 000 km of fire breaks annually but exclusively by mechanical means with only little community involvement. A total of US\$ 5 million is spent on firebreak maintenance every

year. How much of that budget could be used for other fire management purposes if these fire breaks were burned (by members of local communities) instead of being prepared by bulldozers? Not to mention the number of jobs that could be created for the local population, or the “ownership” of the fire management programme this would create.

Still today, fuel reduction as a preventive measure is mostly done by prescribed burning between and around commercial forestry plantations and nature conservation areas. Looking at the extent of fuel reduction measures in sub-Saharan Africa, one may clearly realize that prescribed burning activities have to be significantly increased, especially in the wildland-urban interface, where assets and values are at risk, but that applies to controlled burning in general in fire-adapted ecologies. In the following one example from Botswana: “Even though no one practices prescribed burning in Botswana, the Herbage Preservation Act of 1977 provides for it. But it has not been used because people were not yet sure why they need to obtain a permit to burn their own land. People feared that if they got a burning permit, they may be monitored and be sent to jail if the fire gets out of control or fined just for burning. People are still sceptical as to whether they will be jailed for burning their fields; therefore they prefer to do it illegally by taking chances. Currently the Government of Botswana is not getting any help from other countries in fire fighting aspects” (Mafoko, 2004). The same applies to neighbouring Namibia which receives its fair share of border crossing fires from Botswana, which is lower in elevation than Namibia and thus fires easily move up-hill with the prevailing north-north-easterly winds.

These annual land use fires in Angola, Botswana, Namibia, Zambia and Zimbabwe are forming one of the largest burned areas in the world covering tens of millions hectares; observed border crossing fires have burned 900 000 ha in a single day (NFFP, 1997).

An essential problem in most countries of sub-Saharan Africa is the lack of even basic burning equipment, the lack of basic knowledge of fire behaviour and capacity for the safe use of fire as a tool.

Fire prevention has to start with the knowledge about fire causes; otherwise prevention may target the wrong group in the community. Besides a number of specific community-based fire management programmes (CBFiM) in Tanzania, Mozambique, Namibia and South Africa, prevention programmes tend to address the community in a general way, not considering that fire may play a quite different role in daily life for men, women and children, as they perceive fire differently as well as use fire for different purposes. If, for instance, the major fire cause in an area is abandoned “warming fires” from kids on their way to school (example from the higher altitudes in South Africa), it might be fruitless to try to educate the men of the community about a proper way of smoking out beehives. It is still a good thing, but will not reduce the number of accidental fires in that particular area.

The knowledge about the role of fire in a particular community is a key factor for a successful prevention programme. Conflicts aside, the more efforts are put on education and training of local farmers the less un-controlled fires will occur. The number of fires may almost remain the same but the need for fire detection and fire fighting locally is drastically reduced as experienced in Burkina Faso and Namibia. Besides South Africa, most countries in sub-Saharan Africa do not have sufficient capacities, resources and skills, when it comes to wildfire detection and suppression.

Normally a fire management budget allocates 80-90% of resources into suppression and only 10-20% into prevention. Fortunately this is not the case in many foreign-assisted fire management programmes in Africa, where a strong focus lies on prevention and preparedness. However, a lot of these programmes are only financed for a few years, and they are not sufficiently tied up into a national fire strategy, which would require a permanent annual budget.

However, the fire component of the Namibia-Finland Forestry Programme (NFFP) was run very successfully during the 9 years of the Finnish involvement (since 1996). In a recent assessment in December 2005 of this programme, it became clear, that the above mentioned programme is being successfully managed by the staff of the Directorate of Forestry (DoF) despite of the fact that 10 out of 13 fire-trained people of the Directorate of Forestry, as well as numerous community members, have died of HIV/AIDS or have migrated.

Mainly due to the above mentioned HIV/AIDS pandemic, the fire management skills from Caprivi Region in Namibia were never transferred to other regions of that country before the end of 2004.

The FAO/GFMC/Finland Training Course for Instructors in CBFIM in Republic of South Africa in November 2004<sup>1</sup> was however crucial for Namibia, in that it facilitated the transfer of high level skills and knowledge to other regions in Namibia by the trained Instructors, without whom replication of fire management skills to other regions would most likely not have succeeded.

Another very promising approach in community-based fire management can be observed in South Africa in its Working on Fire Programme (WoF). In short, WoF is a poverty relief programme, which currently employs 1 200 formerly unemployed people as wildland firefighters. The programme proved to be so successful in reducing the effects of uncontrolled fire that a decision was made to increase the number of people to 5 000 fire-fighters. WoF is the main partner of the ISDR Region Sub-Sahara Wildland Fire Network (AfriFireNet) and can be used as a role model for other African countries.<sup>2</sup> AfriFireNet is facilitating the promotion of WoF within the SADC region. The WoF programme is described in detail in Annex 2.<sup>3</sup>

## **2.5 Fire suppression**

Very little capacities within the private sector are available in SSA Region for fire suppression, except in South Africa, and in few other countries south of the Sahara.

Most suppression resources are urban or municipal-based in capitals or bigger cities and do not actually respond to wildfires occurring in the rural areas, sometimes by even lack mandate to deal with wildland fires. Obviously therefore, a number of projects across Africa have been conducted to increase urban and local fire management and suppression capacities. However, most of these projects had little long-term impact after the project termination.

Government priorities change with time, but food security issue tend to remain on top in rural livelihood agenda, including the controlled use of fire.

However, if a fire management budget is available then in most cases 95% of these funds are invested in improving fire suppression and monitoring capabilities, instead of investing in prevention and capacity building.

Through the planned expansion of the Working on Fire Programme into other countries in the SADC region, an approach is made to integrated fire management activities; suppression of course has its role but should not be the main objective of the programme.

There is little more to be said on fire suppression in Africa south of the Sahara.

## **3. Stakeholders / Actors**

### **3.1 Responsibilities and roles**

Traditionally, in the SADC region and neighbouring sub-Saharan countries, the responsibility for wildland fires is with the ministries of Environment/Agriculture and Rural Development. However, an increasing number of countries are following the South African example and are giving the National Disaster Management Centres a share in this mandate; in Tanzania this includes a suggested joint involvement of Forestry staff and staff of the Fire and Rescue Service Force. Stakeholders outside forestry need to be thoroughly trained in issues regarding wildland fire, especially regarding fire behaviour and techniques in use of fire to stop and approaching fire.

---

<sup>1</sup> [http://www.fire.uni-freiburg.de/iffn/iffn\\_31/08-IFFN-31-Afrifirenet-Training-1-2.pdf](http://www.fire.uni-freiburg.de/iffn/iffn_31/08-IFFN-31-Afrifirenet-Training-1-2.pdf)

<sup>2</sup> See section 3.2

<sup>3</sup> See also <http://www.workingonfire.org>

South Africa could be used as an example of a co-operative approach to fire management: Through the National Veld and Forest Fire Act of 1998, the formation of Fire Protection Associations (FPAs) is promoted. All land owners/users, traditional and local authorities are being made aware of their responsibilities in terms of the act and the advantages of dealing with this mandate in a co-operative manner. For instance, a fire management plan is developed for the total area of the Associations, resources are shared, burn permits are issued by the FPAs themselves, etc. The responsibility is shared and in terms of the act the individual is not considered negligent in case a fire incident goes to court. The main national actors in South Africa are the Department of Water and Forestry Affairs, Department of Provincial and Local Government and the National Disaster Management Centre.

However, an important issue remains to be solved, namely the leadership and authority of the person leading the fire suppression activities (Fire Chief).

When multiple layer stakeholders jointly suppress fires, the question arises: under which Act will the Fire Chief operate, and who will have the authority (political-administrative) and/or possess the technical competence.

Therefore countries need to prepare Terms of Reference or a job description for a Fire Chief. Preferably this job description should be copied from the Fire and Rescue ordinance or corresponding document (Jurvélius, 2001). The role and authority of the fire chief has to be clearly defined, especially in commercial farming areas, in relation to regional authorities, e.g. Governors.

Is a Fire Chief authorized to break into buildings, break cattle fences, remove obstructing water pipes, fill fire tankers from local wells, close roads, evacuate schools, etc.? Will the Police and Military be under his command? These are the questions an established "National Fire Council" will have to define, when planning expanded stakeholder participation.

### **3.2 Collaboration**

In most African countries the responsibility for wildland fire management is clearly defined, but all too often, there is no budget to implement even the smallest activities. That fact leads to the issue of cooperation in fire management. Very often, through cooperation, win-win situations develop for the involved partners like in South African where "local to national cooperation" was developed.

Regional co-operative measures were initiated in 2002 through and within the UNISDR Regional Sub-Sahara Wildland Fire Network, AfriFireNet. This network encourages countries to establish or expand cooperative and networking activities between countries at regional level. In some other regions of the world, such regional fire networking activities already existed under various umbrellas. These networks were encouraged to join the ISDR Global Wildland Fire Network (GWFN).<sup>4</sup>

In order to address the serious fire situation in Sub-Saharan Africa where no such networking activity was in place before 2002, the Regional Sub-Sahara Wildland Fire Network (AfriFireNet)<sup>5</sup> was founded in July, under the auspices of the Global Fire Monitoring Center (GFMC). The objectives of the network include:

- Establishment and maintenance of the network through multilaterally agreed mechanisms of communication and information sharing;
- Establishment of partnerships with topical networks, e.g. fire monitoring, early warning of fire, wildland fire science, fire management cooperation and training, etc.;
- Regular communication with network members; contribution to and circulation of International Forest Fire News (ECE/FAO-IFFN);
- Support to the establishment and facilitating of access to use of remote sensing and related technologies for fire and fuel monitoring, fire management planning, and wildfire impact assessment;

---

<sup>4</sup> <http://www.fire.uni-freiburg.de/GlobalNetworks/globalNet.html>

<sup>5</sup> <http://www.fire.uni-freiburg.de/GlobalNetworks/Africa/Afrifirenet.html>

- Creation of an early warning system for wildland fires;
- Contribution to a global fuel status, fire monitoring and impact assessment programme which will secure the contribution for and by the continent;
- Improvement of integrated fire management at regional and national scale;
- Improve research and technology with regard to fire science, and to streamline technology transfer;
- Assist in wildfire disaster management (emergency support);
- Provide/facilitate training at all levels of fire management;
- Promote communication between wildland fire disciplines of Africa and other continents, under the umbrella of the GFMC;
- Contribute to the New Partnership for Africa's Development (NEPAD) through improved fire management.

AfriFireNet has already established cooperative agreements with other topical networks. A main partner is the Global Observation of Forest Cover/Global Observation of Landcover Dynamics (GOFC/GOLD) - Fire Mapping and Monitoring Regional Southern Africa Team (SAFNet).<sup>6</sup>

In support of the urgently required, fire management training activities in the Sub-Saharan Africa, the GFMC and the former coordinator of AfriFireNet have in 2004 prepared the Wildland Fire Management Handbook for Sub-Saharan Africa (Goldammer and de Ronde, 2004). Funding for this book was provided by the German Foreign Office and by the UNISDR. This handbook is a contribution to the New Partnership for Africa's Development (NEPAD).

As one of the first activities of AfriFireNet, a Wildland Fire Training Center Africa (WFTCA) was founded in cooperation with local partners in South Africa, to tackle the urgent need for capacity building at all levels of fire management. The WFCTA offers training and education opportunities for a wide range of fire managers, fire management trainers and extension officers from all African countries south of the Sahara. WFCTA also offers international guests and collaborators such as for the international non-governmental organizations (INGOs) of Global Fire Partnership, the exposure to large-scale prescribed burning operations and fire fighting under African ecologies. All training is done with a strong practical aspect.<sup>7</sup>

Like most other institutions in Africa, the WFTCA budget is very limited and depends on donor funding.

However, in cooperation with the governments of South Africa, Germany, Finland, Norway and Mozambique, the Food and Agriculture Organization of the United Nations (FAO) and UNISDR, a number of international training courses were successfully conducted over the last two years. Obviously these training courses are a kind of a short-term solution, but at least they bring fire managers from different countries together and these trained persons can spread the "fire" message back home in their own countries and act as focal points in further fire cooperation.

Due to these network activities, a fruitful communication already developed between South Africa, Botswana, Zimbabwe, Zambia, Namibia, Tanzania and the Democratic Republic of the Congo. The main issue in these talks and plans is the establishment of bilateral cooperative fire agreements to enable an easy way of exchanging information, experience, training and resources, in case of cross border fires or major fire disasters. AfriFireNet is supporting and facilitating these activities and South Africa, through the Working on Fire (WoF) programme, and is willing to assist the neighbouring countries in the development of sustainable fire management.

The basic conditions for a cooperation in fire management in the Sub-Saharan region is basically already in place. Articles 3, 15 and 22 of the SADC Protocol on Forestry already provide an enabling framework for cooperation; now it just needs to be implemented by the nations. The SADC Secretariat should become one of the biggest and most important role players in fire; it could also take over a coordinating role and in addition provide help in securing funding. Unfortunately, however, the SADC Secretariat announced that starting from 1 April 2005, all Natural Resources

<sup>6</sup> <http://safnet.umd.edu/>

<sup>7</sup> <http://www.fire.uni-freiburg.de/GlobalNetworks/Africa/WFTCA.htm>

Management (NRM) programmes will be closed down, as well as the Environment and Sustainable Management Unit which, it was foreseen, would have played a coordinating role in integrated fire management in the SADC region.

Another encouraging example of international cooperation in SSA comes from West and Central Africa where, on 7 February 2005, the First Region-wide Conservation Treaty was signed at the historic Congo Basin Forest Summit. The signing of Africa's first ever region-wide conservation treaty and an agreement to protect over 7 percent of the Congo Basin forests are historic milestones for the future of the world's second largest rainforest. The treaty was signed by the Presidents of 10 Central African nations (Republic of the Congo, Cameroon, Gabon, Democratic Republic of the Congo (DRC), Central African Republic, Equatorial Guinea, Chad, Sao Tome and Principe, Rwanda, and Burundi) during the Second Heads of State Forest Summit in Brazzaville, Republic of the Congo. It legally recognizes the Central African Forests Commission (COMIFAC) as the only decision-making body on forests for the Central African Region. Meanwhile, the TRIDOM Agreement between Cameroon, Gabon and the Republic of the Congo will protect approximately 15 million ha of forests, including Dja, Odzala and Minkebe National Parks, the equivalent of 7.5 percent of the entire Congo Basin.

The treaty and the TRIDOM agreement will help Central African countries cooperate across borders in protected areas management, to tackle poaching and the illicit bush meat trade, as well as illegal logging. These activities are particularly detrimental for the livelihood and culture of the local pygmy communities (Carroll, 2004). Also signed at the Summit was an accord allowing free movement of park staff between Cameroon, Central African Republic and Republic of the Congo in the Sangha Tri-National Conservation Area. This means that park staff can work across international borders to fight poaching and illegal logging.

Central Africa is a model for the entire world on how to reach across borders to tackle the tough issues that are threatening wildlife, forests and the livelihoods of local communities (Carroll, 2004).

The issue of uncontrolled fires was not mentioned or incorporated in the above mentioned treaty for whatever reason. As a fact, hundreds of thousands of fires burn annually in the Congo Basin and are a major threat to the forest, biodiversity and the affected population. However, this treaty could also provide the foundation for cooperation in fire management. The first measures in that direction are undertaken by the Democratic Republic of the Congo.

In addition to the above elaborated activities, the issue has furthermore been of concern on a high political level at the UNISDR and FAO, as the following extract from a report for the 24<sup>th</sup> Regional Conference for Africa (FAO, 2006) reveals:

“In 1998, FAO organized a global expert consultation of public policies affecting forest fires. This concluded that countries need to formulate flexible fire management policies that take account of prevailing landuse practices. Implementation should be realistic and based on clear objectives, with all stakeholders being involved. The policies should also address those land uses that impinge on forests, specifically the underlying causes of deforestation, with incentives being provided for fire prevention, where appropriate (FAO, 1999).

This was followed in 2001 by an expert meeting on the international implications of national actions. The recommendations included the need to develop human resources and mechanisms to support bilateral, regional and international cooperation on forest fire management; to establish a basis for inter-country agreements in this regard; and to build a database on legal frameworks, international agreements and national legislation covering the management of forest fire (FAO, 2002).

At the same time, a *Working Group on Wildland Fire* (WGWF) was established under the Inter-Agency Task Force for Disaster Reduction within UNISDR. Its aims were to establish a Global Wildland Fire Network to enhance existing capabilities in fire monitoring, early warning and impact assessment, and to facilitate international cooperation in fire management. In 2004, this became the UNISDR *Wildland Fire Advisory Group*, to serve as an interagency advisory body to the UN on fire issues and to continue the work of the WGWF.

In October 2003, the 3<sup>rd</sup> International Wildland Fire Summit was held in Sydney, Australia. The summit endorsed the need to enhance international cooperation in wildland fire management through agreements on common principles, procedures and a common global strategy, and request the United Nations and its specialized agencies to take the lead in implementing the strategy, including securing funding to support the establishment of regional networks and other fora for action. Accordingly, FAO together with the UNISDR, are organizing an International Liaison Committee and Expert Consultation on Wildland and Forest Fire Management in Madrid in May 2006 as a lead up to the 4<sup>th</sup> Global Wildland Fire Summit in Madrid, Spain, in May 2007.

The view that forest fires are causing grave ecological, economic and human damage was taken up by the African Forestry and Wildlife Commission at its 14<sup>th</sup> Session held in Accra, Ghana, 18-21 February 2004. The Commission encouraged its members to reassess and strengthen commitment to combat such fires and to develop the necessary bilateral, sub-regional and regional cooperative structures to do this.

At a national level, this involves the proper combination of education and extension to support community-based forest fire management and appropriate organisation and deployment of equipment at various levels. The Commission recommended that appropriate case studies be undertaken of the economic costs of the damage caused by fires, so as to increase awareness of the need and political commitment to combat them. It also recommended that FAO continue its work to support cooperation in forest fire management through various bilateral, regional and global agreements.

The Ministerial Meeting on Forests, held in Rome on 14 March 2005 and attended by ministers and senior officials representing 127 Members, called on FAO, in collaboration with countries and other international partners, including the UNISDR, to develop a strategy to enhance international cooperation on wildland fires to advance knowledge, increase access to information and resources, and explore new approaches for cooperation at all levels.

Whilst recognizing that the indiscriminate and uncontrolled use of fire can have negative social, economic and environmental impacts, including contributing to forest degradation, the ministerial declaration emphasised the need for more attention to be given to forest fires in the context of sustainable development, and acknowledged the importance of fire as an ecological process and land management tool.

As follow-up, the Committee on Forestry (COFO), at its 17<sup>th</sup> session held in Rome on 15-19 March 2005, in turn recommended that the Regional Forestry Commissions facilitate action and dialogue regionally and sub-regionally, with the aim of fostering collaboration on forest fire management.

COFO also requested FAO, in collaboration with countries and other international partners, including the UNISDR, to develop a strategy for international cooperation on wildland fire, to help countries develop and consolidate their national fire management systems and build the necessary technical and operational capacity to cooperate effectively. The committee recommended that FAO continue to support regional and national networks to combat fire, and work with partners to develop voluntary guidelines on the prevention, suppression and recovery from forest fire.

The Committee further recommended that FAO advocate an integrated approach to both fire and forest management, recognizing that sustainable forest management is an effective means of fire prevention, and that fire is an important management tool in both agriculture and forestry. This would include technical support for improved management of fuel loads in forests; design and implementation of training, education and awareness-raising programmes on forest fire management, especially at a local level; and further efforts to monitor and manage information on forest fire management, and disseminate the results. In this regard, FAO and its international partners are in the process of developing Voluntary Guidelines for Forest Fire Management, to be presented as an information item for

endorsement of the process at the African Forest and Wildlife Commission, March 2006 and reviewed at the expert consultation in May 2006, for presentation to COFO, 2007.

The Committee noted the special needs of developing countries and recommended that they include forest fire management in their dialogue with international assistance agencies of developed countries, as well as with the World Bank and regional development banks. The detailed recommendations are listed in FAO (2005b).”

### **3.3 Community involvement**

Due to the fact that the overwhelming majority of all wildland fires in the region are caused by human activities, it is necessary to address the reasons for these fires, rather than only trying to increase the suppression capacity or by tightening fire legislation. Proactive fire management approaches are needed to establish data on the underlying causes of fires, only then it is possible to develop national strategies in the appropriate use of fire as a management tool.

However, national budgetary constraints of SSA governments have basically eliminated their capacity to regulate everything from the central governments; therefore there is a growing trend towards decentralized decision making. However, the shortage of resources for enforcing the decentralization process means that there is little capacity with the central government to support local resource management initiatives. This trend results in little or no effective fire management and this problem is compounded by excessive sectoralism in many governments, leading to uncoordinated policy development, establishment of conflicting policies, and a duplication of effort and resources.

As a result, community-based natural resource management is now increasingly being widely implemented in Africa, with the recognition that local management is the appropriate level at which to address the widespread fire problems of Africa. The major challenge is to create an enabling rather than a regulatory framework for effective fire management in Africa, but this is not currently in place in many countries. Community-based natural resource management programmes, with provisions for fire management through proper infrastructure development, must be encouraged (Goldammer and de Ronde, 2004).

Some forestry and wildlife management agencies within the region have the basic infrastructure to detect, prevent and suppress fires, but this capability is rapidly breaking down and becoming obsolete. Traditional controls on burning in customary lands are now largely ineffective. Fire control is also greatly complicated by the fact that the hundreds of thousands fires in Africa occur as widely dispersed small events, primarily related to agricultural seasons. Therefore, these fires can only be addressed and dealt with at community level.

There is a need to raise the awareness of local people and provide training to multiple level stakeholders in the proper use of fire as a management tool in rural activities at landscape level. By managing fires at local level, resources, including forests, can be managed sustainably.

There is also a need to apply an ecosystem approach, wherein all fires, regardless of its purpose (agriculture, land clearing, beekeeping, hunting, cooking, heating), are managed by the local people. With the national forestry departments as lead agency, all uses of fire should be coordinated by a community level fire management unit.

Very encouraging Community-Based Fire Management (CBFiM) programmes have been established in Burkina Faso, Mozambique, Namibia and South Africa (Goldammer *et al.*, 2001). The results and experiences of these projects were presented and summarized at the FAO/GFMC/UNU Training Course for Instructors in CBFiM, which was held in South Africa in October 2004. Represented at this AfriFireNet event were Botswana, Ethiopia, Ghana, Guatemala, Hungary, Namibia, South Africa, Sudan, Syria, Tanzania, Zambia and Zimbabwe. The very positive and promising results of these projects show that in Africa the community approach is probably the only sustainable and long-term solution to improve the fire situation where used at the community grassroots level.

### **3.4 Needs and limitations**

The prevailing lack of financial, infrastructural and equipment resources for fire management in the SADC Region and neighbouring Sub-Saharan Africa is aggravated by the lack of human resources adequately trained in fire management. The gap between the decreasing preparedness capabilities in fire management and the increasing fire problems in the SADC Region/Sub-Saharan Africa requires immediate response through capacity building (Goldammer and de Ronde, 2004).

The major limitations, as elaborated above, for integrated fire management are firstly budgetary constraints, missing infrastructure and capacities, and a social and political environment that are not sufficiently enabling or empowering the affected population to deal themselves with the fire problem. The challenge is how to convince policy makers to provide their support to the community. The issue of sharing responsibility and therefore power is a difficult equation in the political world.

Fortunately, the population and the mid-level decision makers in most Sub-Saharan countries do recognize the increasing fire problems and are more than willing to participate and work towards an integrated fire management approach. This positive environment and spirit is forming a promising basis despite the missing funding. A starting point would be the creation of a professional position within the directorates of forestry, exclusively dealing with vegetation fires. Having a dedicated and well trained person working in such a position is the first step towards a change towards a better use and control of fires locally.

The expertise, motivation and the technical means are already available in Africa. The challenge is to place them in a sustainable integrated fire management system with necessary budgets allocated.

These needs must also be considered within the context of a myriad of problems facing governments and communities in Africa, including wars, poverty, exploding populations, migration and health (e.g., HIV). While unwarranted and uncontrolled burning may greatly affect sustainable resource management at the local scale, it may not yet be sufficiently important to warrant the concern of policy makers, and that perception must be challenged as a first step towards more deliberate, controlled and responsible use of fire in Africa (Goldammer and de Ronde, 2004).

## **4. Analysis and Recommendations**

As elaborated and discussed above, Integrated Fire Management approaches in Sub-Saharan Africa are facing an incredible number of difficulties and obstacles. The lack of funding and of sound and sustainable fire management strategies are the most prominent ones.

However, having mentioned only a few examples, there are very encouraging ones, role models and many motivated people who want to actively change the unacceptable fire situation in their nation, region and on the continent.

Wildland fire management in SSA is almost exclusively an agricultural theme or affair; the key is to involve agriculture to assume its responsibility in using fires in controlled way. Forest fires mostly start from uncontrolled agricultural fires, which spread in to forested areas.

- Each country should analyze its fire situation and the specific fire causes and develop a strategy, based on the findings, for preventing and managing wildland fire issues. Very often, local communities alone are not capable of managing intense and large fires. In these cases support from provincial or national level agencies is crucial.
- In some countries, more effective law enforcement against arsonists is an important part of the solution. In other countries, awareness of fire prevention and control need to be increased, especially at the wildland-residential interface where housing is constructed inside naturally fire-prone vegetation. Improved monitoring may be required and fire reporting mechanisms should be established for people to report fires.

- Governments which are willing to try to improve the fire situation in their country should allocate a small, but sustainable budget and create a position, for instance, into the Ministry of Forestry which deals exclusively with fire management. A clear and dedicated mandate for all aspects of wildland fire management would help to coordinate all efforts, be it a community approach, development of a progressive and enabling legislation, capacity building, fire danger rating or classic fire suppression.
- International cooperation for wildland fire management in Sub-Saharan Africa is being promoted and facilitated through the thematic networks Afrifirenet and GOF-C-GOLD-SAFNET. The international exchange is important to ensure the exchange of experiences, ideas, resources and sometimes even funding. Sharing of expensive resources like satellite data or aerial resources is another advantage.
- A number of regional or international organizations in Sub-Saharan Africa could take over a leading coordinating and supporting role, such as SADC, NEPAD, African Union, African Development Bank, FAO, GFMC just to name a few. To develop and take over responsibility in wildland fire management are only possible if member states of SADC, for instance, nominate and give a mandate to the SADC Secretariat.
- An additional option, already discussed in various conferences, would be the establishment of one or more regional “Wildland Fire Management Centres”, as centres of excellence, available to assist and support the countries in the specific region. Funding for an approach like this could come from the region as well as from the international community, which would greatly benefit from reduced carbon emissions and from sustainable management of forests in Sub-Saharan Africa.
- There is already a huge reservoir of expertise available within the different regions in Africa. There is no need to re-invent the wheel when aiming at promoting and implementing integrated fire management in Sub-Saharan Africa.
- For countries to be able to manage their fires in an ecologically acceptable way, there is a need to improve the regional monitoring of fires as well as to increase the scientific understanding of fires.
- Additional information is needed on the ecological dynamics of fire, desired long-term ecosystem conditions and on the underlying causes on fire.
- Staff responsible for forest fire management and local people alike need to appreciate and understand the role and relationship between the basic components of fire (fuel, heat, oxygen), as well as the principles of fire behaviour. In addition, they need to master, at least in principle the skills of prescribed burning. Such knowledge will form the basis of a more common understanding of local fire ecology, including the role of trees and forests and the requirements of fire for regeneration of forests and trees.
- The adverse economic, social and environmental impacts of HIV/AIDS are becoming increasingly evident, and have reached catastrophic dimensions in many regions, notably in Sub-Saharan Africa. Countries are facing formidable challenges in attempting to mitigate the impacts. There is an urgent need to help countries in distress to develop and implement multi-sectoral strategies to face the multitude of problems which have emerged. Therefore it is a need to combine HIV/AIDS education, targeting youth, with the local education in fire management in the countries worst hit by the pandemic. This educational activity will help to lessen the occurrence of wildfires started in connection with agricultural land clearing activities which, over the past years, have increased due to labour shortages and lack of experience by the often orphaned youth presently carrying out the task

## REFERENCES

- Andreae, M.O. 1997. Emissions of trace gases and aerosols from southern African savanna fires. In: Fire in Southern African Savannas. Ecological and Atmospheric Perspectives (B.W. van Wilgen, M.O. Andreae, J.G. Goldammer, and J.A. Lindsay, eds.), 161-183. University of Witwatersrand Press, Johannesburg.
- Andreae, M.O. 2004. Assessment of global emissions from vegetation fires. *International Forest Fire News*, 31, 112-121.
- Anonymous. 2004. Working on Fire. Integrated Fire Management in Eight Pilot Umbrella Fire Protection Associations in South Africa. <http://www.fire.uni-freiburg.de/WoF/>
- Barbosa, P.M., D. Stroppiana, J.-M. Grégoire and J.M.C. Pereira. 1999. An assessment of vegetation fire in Africa (1981-1991): Burned areas, burned biomass and atmospheric emissions. *Global Biogeochemical Cycles* 13, 933-950.
- Carrol, M. 2004. WWF Press Release. [www.panda.org](http://www.panda.org).
- FAO. 1999. FAO Meeting on Public Policies Affecting Forest Fires. Forestry Paper 138. Forestry Department, FAO, Rome.
- FAO. 2001. Global Forest Fire Assessment 1990-2000. Forest Resources Assessment Programme, Working Paper 55, Forestry Department, FAO, Rome.
- FAO. 2002. Report on Legal Frameworks for Forest Fire Management: International Agreements and National Legislation. FAO, Rome.
- FAO. 2004. Report of the Fourteenth Session of the African Forestry and Wildlife Commission, Accra, Ghana, 18-21 February 2004. AFWC/2004/REP. FAO, Rome. (<ftp://ftp.fao.org/docrep/fao/meeting/007/j2042e/j2042e00.pdf>)
- FAO. 2005a. Statement of the Ministerial Meeting on Forests, 14 March 2005. In: Proceedings of 128<sup>th</sup> Session of the FAO Council, Rome, 20-25 June 2005. (<http://www.fao.org/docrep/meeting/009/j5108e.htm>)
- FAO. 2005b. Report of the 17<sup>th</sup> Session of the Committee on Forestry, 15-19 March 2005, FAO, Rome (<http://www.fao.org/docrep/meeting/009/j5015e.htm>)
- FAO. 2006. Fire In The Agriculture-Forestry Interface. Report prepared for the 24<sup>th</sup> FAO Regional Conference for Africa, Bamako, Mali, 30 January - 3 February 2006.
- Frost, P.G.H., and F. Robertson. 1987. The ecological effects of fire in savannas. In: B.H. Walker (ed.) *Determinants of Tropical Savannas*, pp. 93-140. IRL Press, Oxford.
- Goldammer, J.G., P.G.H. Frost, M. Jurvélius, E.M. Kamminga, T. Kruger, S. Ing Moody, M. Pogeyed. 2002. Community Participation in Integrated Forest Fire Management: Experiences from Africa, Asia and Europe. In: *Communities in Flames*. Proceedings of an International Conference on Community Involvement in Fire Management, 25-28 July 2001, Balikpapan, Indonesia (P. Moore, D. Ganz, L. Cheng Tan, T. Enters, and P.B. Durst, eds.), 33-52. FAO Regional Office for Asia and the Pacific, Bangkok, Thailand. RAP Publication 2002/25, 133 p.
- Goldammer, J.G., and C. de Ronde (eds.). 2004. *Wildland Fire Management Handbook for Sub-Saharan Africa*. Global Fire Monitoring Center and Oneworldbooks, Freiburg – Cape Town, 432 p.
- Heine, J. 2004. Working on Fire, WoF Management Report 2003. <http://www.fire.uni-freiburg.de/WoF/report.html>
- Jurvélius, M. 2001. Draft Guidelines for Forest Fire Management in Namibia, Windhoek, <http://www.fao.org/forestry/foris/webview/forestry2/index.jsp?siteId=1520&siteTreeId=3442&langId=1&geoid=0> or [http://www.fire.uni-freiburg.de/iffn/country/na/na\\_8.htm](http://www.fire.uni-freiburg.de/iffn/country/na/na_8.htm)
- JRC-EU. 2005. SAFARI 2000 Global Burned Area Map, 1-km, Southern Africa, 2000. Data set. Joint Research Centre, European Union, Ispra, Italy [available on-line at <http://daac.ornl.gov/> from Oak Ridge National Laboratory Distributed Active Archive Center, Oak Ridge, Tennessee, U.S.A.]
- Mafoko, J.G. 2005. Global Wildland Fire Assessment 2004 – Botswana Country Report, 5-13. Gaborone, Botswana, 16 p (on file at the Global Fire Monitoring Center).
- NFFP, 1997. Namibia-Finland Forestry Programme; Section on fire scar mapping, Progress Report 1997.
- Phillips, J. 1965. Fire – as a master and servant: Its influence in the bioclimatic regions of Trans-Saharan Africa. *Proc. Tall Timbers Fire Ecology Conf.* 4, 7-10.
- Pyne, S.J. 2004. *Wildland Fire Management Handbook for Sub-Saharan Africa* (J.G. Goldammer and C. de Ronde, eds.) Global Fire Monitoring Center and Oneworldbooks, Freiburg - Cape Town, 432 p.

- Silva, J.M.N., J.M.C. Pereira, A.I. Cabral, A.C.L. Sa, M.J.P. Vasconcelos, B. Mota, and J.-M. Gregoire. 2003. An estimate of the area burned in southern Africa during the 2000 dry season using SPOT-VEGETATION satellite data. *Journal of Geophysical Research*, 108(D13), 8498, doi:10.1029/2002JD002320.
- USFS. 1993. Systematic Fire Protection and International Forestry. A Case Study in Botswana. United States Department of Agriculture, Forest Service Report R6-FAM-PR-017-93, USDA Forest Service, Pacific Northwest Region, Portland, Oregon.

## Annex 1

The tables below give statistical fire data for some African countries. The data were obtained from “Global Burned Area 2000” (GBA) and/or national statistics. One has to state that the quality of the presented data is poor. The satellite product is only a one-year observation with no comparable data from other years. Was 2000 a representative year? In a few cases the GBA data could be compared to other statistical data. In most cases GBA had an overestimation of burned area; however, underestimations occurred also but to a lesser degree.

For comparison and to show the current uncertainties a second table with representative fire data from the JRC-EU is presented.

The quality of national statistical data is also questionable as they are influenced by politics, different definitions, standards, reporting schemes, etc. For some countries both data are presented to give the reader an example how these data differ from each other.

Agriculturists, ecologists and forest staff need to be trained and educated in the differences between good or useful fires, and bad or destructive fires, including knowledge in how to use the right kind of fire in fire-adapted ecologies and to extinguish harmful fires in fire-sensitive ecologies.

There is a clear need for a harmonized reporting system for statistical fire data, using the same definitions and standards. In the authors’ opinion, it would be more feasible to improve the remote sensing tools for burned area observation than improving on-the-ground data recording in Africa.

When collecting information on wildland and forest fires, the importance to also assess the impact of these fires on various ecosystems need to be recognized in the SSA. Ecosystems globally can be divided into fire-dependent; fire-sensitive and fire-independent ecosystems. However, data from many countries often deals with national data on *fire-sensitive* ecosystems and does not always cover all wildland fires, let alone fires in fire-adapted woodlands and savanna ecosystems.

**Table 1.** Wildland fire statistics for countries of the Sub-Saharan Africa Region.

Country	Years	Area Burned (ha)	Source
Angola	2000	68 600	GBA
<b>Botswana</b>	1988-2004	<b>2 083 295</b>	<b>Nat. Stat.</b>
	2000	<b>3 352 300</b>	<b>GBA</b>
Burkina Faso	2000	15 813	GBA
Burundi	2000	72 100	GBA
Cameroon	2000	4 992 800	GBA
Central African Rep.	2000	18 516 000	GBA
Chad	2000	8 041 900	GBA
Congo	2000	581 000	GBA
Congo, D.R.	2000	26 091 000	GBA
<b>Côte d'Ivoire</b>	1983-1998	<b>5 437</b>	<b>Nat. Stat.</b>
	2000	<b>20 84 100</b>	<b>GBA</b>
Djibouti	2000	42 100	GBA
Equ. Guinea	2000	1 900	GBA
<b>Ethiopia</b>	1990-1999	<b>1 218</b>	<b>Nat. Stat.</b>
	2000	<b>13 634 700</b>	<b>GBA</b>
Gambia	2000	81 400	GBA
Ghana	2000	5 374 700	GBA
Guinea	2000	799 900	GBA
<b>Kenya</b>	1990-2000	<b>7 142</b>	<b>Nat. Stat.</b>
	2000	<b>5 765 400</b>	<b>GBA</b>
Lesotho	2000	172 300	GBA
Malawi	2000	548 700	GBA
Mali	2000	2 180 900	GBA
Mozambique	2000	10 286 000	GBA
<b>Namibia</b>	1990-2000	<b>4 000 000</b>	<b>Nat. Stat.</b>
	2000	<b>35 097</b>	<b>GBA</b>
Niger	2000	340 900	GBA
Nigeria	2000	3 190 000	GBA
Rwanda	2000	60 300	GBA
<b>Senegal</b>	1994-1998	<b>394 178</b>	<b>Nat. Stat.</b>
	2000	<b>1 137 700</b>	<b>GBA</b>
Sierra Leone	2000	102 600	GBA
Somalia	2000	18 311 900	GBA
<b>South Africa</b>	1990-2000	<b>40 000 000</b>	<b>Nat. Stat.</b>
	2000	<b>7 367 000</b>	<b>GBA</b>
Sudan	2000	40475400	GBA
Swaziland	2000	48 300	GBA
<b>Tanzania</b>	1990-2000	<b>65 000</b>	<b>GBA</b>
	2000	<b>12 196 900</b>	<b>GBA</b>
Togo	2000	642 000	GBA
Uganda	2000	3 139 200	GBA
Zambia	2000	11 015 400	GBA
Zimbabwe	2000	1 751 300	GBA

Sources: GBA-2000, national reports of the Global Wildland Fire Assessment 2004 and GFMC database.

**Table 2.** Extent of burning in the most widely burned countries in Africa in 2000.

<b>Country</b>	<b>Area burned (km<sup>2</sup>)</b>	<b>Percent of country</b>
Central African Republic	185 479	30.0
Angola	296 545	23.7
Ghana	53 747	22.5
Sudan	403 009	16.2
Zambia	110 285	14.7
Mozambique	102 618	13.1
Tanzania	121 969	13.0
Uganda	31 392	13.0
Togo	6 393	11.8
Ethiopia	140 919	11.3
Democratic Republic of Congo	260 032	11.2
Benin	13 003	11.2
Cameroon	49 928	10.7

Source: JRC-EU (2005)

## Annex 2

### South African “Working on Fire” Programme

The following will provide a short description about the South African “Working on Fire” programme (WoF), which could serve as a useful model for a national integrated fire management programme for other African countries. WoF is still a young initiative and started in 2003 only. WoF is a poverty relief and social uplift programme, with the aim to establish an integrated fire management system on a nationwide basis.

A statement from WoF Management:

“Managers of Working on Fire are trained to assist the Department of Water Affairs and Forestry, and Local and District Authorities, local communities and landowners in the formation, co-ordination and running of Fire Protection Associations (FPA) and Umbrella Fire Protection Associations (UFPA) in the areas where we have established fire bases. This is done under the National Veld and Forest Fire Act of 1998.

Working on Fire offers services to FPA members which can include access to specialized wildland fire (veld fire) fighting training, an option to receive regular weather forecasting and Fire Danger Rating information, and the option to subscribe to aerial and ground fire fighting resources at a reduced price.

Each of the present 40 WoF bases operate under a collaborative agreement with at least one partner organization. Expansion to further areas is anticipated in the future. Partners contribute by making available transport, crew stand-by and operation room facilities as well as managing the day-to-day activities and deployment of Hot Shot Crews. In return, the resources of Working on Fire are available to undertake partners’ prevention and suppression activities at preferential/ subsidized rates.

WoF plans to be part of the initial attack strategy and tactics of local organizations in order to assist its partners to control fires, wherever possible. Working on Fire’s aerial and ground resources are available to partners first, and this would include members whose FPA’s have a written agreement with the Working on Fire.

A rigorous recruiting process, followed by life skills and fire fighting training, ensures that hot shot crews are physically fit, capable of high endurance levels and trained to international fire fighting standards. This empowering process gives crew members dignity and leads to increased status within their communities.

The WoF ensures the safety of its people through instilling a code of strict discipline and fitness and equipping them with the best personal protective equipment possible. WoF supplies its fire fighters with the correct tools and equipment in order to empower them to carry out their integrated fire management functions to the best of their abilities. All WoF teams have mop up training and use cold trailing hand-held infra-red heat detectors to ensure that fires do not re-ignite because they were not properly mopped-up.

Out of the fire season, ground crews carry out fire prevention work such as fuel reduction, prescribed burning and clearing of fire breaks.

WoF supplies and co-ordinates nationally-sponsored aerial fire fighting resources to its partners, in reaction to disaster or potential disaster situations, and in support of ground fire fighting resources. Distinct from the day-to-day operation of the local fire control organization, WoF is capable of supplying, through the National Disaster Management Centre, internationally-trained Incident Command Teams and resources if required on a major fire. These ICS Teams will take over responsibility of management if fire suppression operations go into extended attack and outstrip local resources.

WoF supports and co-ordinates public education on destructive and beneficial properties of fire by holding open days and participating in public events. Every WoF fire fighter is able to contribute knowledge about fire awareness when talking to the community.

WoF is carrying out research into new technologies, training and best practice operating procedures. WoF continuously strives to improve operating systems and build knowledge that can be applied in bringing fire prevention benefits to communities affected by fire. Cross-border and international collaboration with wild land fire research and development organisations result in regular reciprocal cross training visits and workshops.”

### **Integrated Fire Management**

The concept of integrated fire management includes a fire awareness component, fire prevention activities, prescribed burning, resource sharing and co-ordination, fire detection, fire suppression and fire damage rehabilitation at local, provincial and national levels in order to create a sustainable and well balanced environment, reduce unwanted wildfire damage and promote the beneficial use of fire.

The vast majority of “unwanted” fires are caused by people. This is why fire awareness raising programmes need to target people.

Technical measures of fire Prevention are accomplished by either removing the source of the firebrand or removing the fuel it may ignite. It is the first line of defence. Preparation and regular maintenance of fire breaks and fuel reduction through block burning are strategies that use fire as a tool to reduce wildfire risk. Control and maintenance of fire – prone invasive alien plants, fireproofing and fuel reduction by removing fuel loads – are additional fire prevention strategies. National legislation and local bylaws may be enforced, when landowners are negligent of their responsibilities.

### **Prescribed Burning**

Many of South Africa’s biologically diverse ecosystems are fire adapted and depend on fire to regenerate and survive. However, in many areas a nature-driven fire regime is no longer possible. The environment and its fuel load may need to be managed to reduce wildfire risk, while maintaining ecological patterns and processes, by using fire in a prescribed burning programme.

### **Resource, Operational and Jurisdictional Co-ordination**

Numerous Co-ordinating Centres co-ordinate the various local, provincial and national fire fighting organizations’ resources, needs and actions. This is vital for efficient, effective and safe operations. Not all fire departments or organizations have wildland fire protection as their primary mission - the majority are involved with a wildland fire on occasion. In order to promote integrated fire management throughout South Africa, it is necessary to concentrate on addressing the co-ordinated management of wildland fires, as well as the establishment of efficiently operating Umbrella Fire Protection Associations. Key to the success of effective integrated fire management are operations centres, well staffed and efficient, able to set priorities, move resources as required, and monitor the weather in order to forecast special weather conditions that favour rapid spread of fire. Implementing, co-ordinating and monitoring readiness actions according to weather conditions are essential to ensure the success of initial attack.

Large, uncontrolled fires are a problem for wildland fire fighting organizations world-wide. In many respects, such ‘potential disaster’ fires are a problem distinct from day-to-day operations. From anticipated disaster through to the point at which they become an extreme emergency, requiring extended attack; large fires need sophisticated operational co-ordination. Internationally trained and accredited Incident Command Teams are specifically trained in order to adapt and fit into any type and size of incident that requires extended attack.

### **Fire Detection**

Before anything can be done about controlling a fire, its existence must be known. WoF is promoting an integrated fire detection system for South Africa. This will draw on and combine all available means to ensure that every wildfire that occurs is discovered and reported to a co-ordinating centre early enough for it to be controlled or managed by the local fire fighting force.

### **Fire Suppression**

All fires start small and the objective is to keep them small, controlling them before they cause injury to the public or seriously damage property and resources. This requires initial attack strategies and

tactics to control or contain fires in the safest, most efficient and cost-effective manner. Initial attack is deemed successful when the fire is contained before it can outstrip the locally available fire fighting resources.

Large, uncontrolled fires are a national problem. This can be due to errors or failures in performance in making a successful initial attack on the fire, and should be addressed using the Incident Command System (ICS). This command system can be adapted to fit any type or size of incident, whether it is a veld fire, flood or earthquake. If the ICS is not implemented correctly, the initial attack errors are followed by similar containment failures at later stages, resulting in missed opportunities to control the fire at a lower level of damage or costs than finally incurred.

After a fire has been contained, the ground crews go over the area to ensure that all burning and smouldering material is extinguished, in order to prevent the fire re-igniting. This is called “mopping up” and it is a critical element of successful fire suppression

### **Post-Fire Rehabilitation**

Fire can have a destabilizing effect on land. After an “unwanted” fire, land should be evaluated in order to establish whether there is a danger of landslide or erosion. In some instances intervention is necessary in order to ensure all resource management perspectives will be met. Fire damage rehabilitation measures should be initiated when required.

A critical, if not the most critical factor contributing to the operational layout of the WoF programme, has been that of partnership. In the initial period, 40 firebases have been established across the fire-prone regions of the country and in most cases, bases are in partnership with a local community, local or district authority, fire protection or conservation agency. All role players are on board and contributing to a common strategy.

Over 1 000 trained personnel, 64% of them under thirty-five years old, are now employed in 22-person firefighting hand crews and “on the ground” management, available to assist partners in preventing and suppressing unwanted fires. Most were previously unemployed and for many, this is the first regular income earned.

In addition to person power on the ground, six helicopters, 25 fixed-wing water bombers and 15 spotter aircraft flown by highly experienced pilots are presently coordinated from six dispatch centres, in conjunction with national partners.

Ground and aerial support from around South Africa can be rapidly mobilized to assist with prevention and suppression of disaster or potential disaster fires, and have been deployed during the last fire season to do just this. Pooling of fire management resources, fuel reduction and establishment of Fire Protection Associations are proven efficiency measures in an integrated fire management programme.

As all WoF personnel is recruited from local communities, the training, awareness, education and change of attitude is transported back to the communities and multiplied. Recent research has revealed that one trained WoF firefighter is influencing 25-30 persons within his community.

For other African countries, the basic outlines of that programme would have to be adapted and modified according to local circumstances and most probably without the involvement of a big aerial firefighting fleet commonly used in the RSA.

**For details see:** [www.workingonfire.org](http://www.workingonfire.org)

## PUBLICATIONS AVAILABLE ON FIRE MANAGEMENT

### *Fire Management Working Papers: Thematic Paper Series*

Note:

In Code "Working Paper FM/xx", "x" indicates the WP series number and a suffix E, F or S indicates: E = English, F = French, S = Spanish, in case of multilingual papers. No suffix indicates E only.

### **Available at the Fire Management web site:**

Working Paper FPF/1	<i>Guidelines on Fire Management in Temperate and Boreal Forests.</i> November 2002.
Working Paper FM/2	<i>International Wildland Fire Management Agreements Template.</i> Tom Frey, Ricardo Vélez Muñoz. January 2004.
Working Paper FM/3	<i>Legal Frameworks for Forest Fire Management: International Agreements and National Legislation.</i> Fernando Fernández Arriaga, Frédéric St-Martin, Tom Frey, Ricardo Vélez Muñoz. March 2004.
Working Paper FM/4	<i>Community-Based Fire Management in Spain.</i> Ricardo Vélez Muñoz. April 2005.
Working Paper FM/5	<i>Report on Fires in the South American Region.</i> María Isabel Manta Nolasco. March 2006.
Working Paper FM/6	<i>Report on Fires in the North East Asian Region.</i> Leonid Kondrashov. March 2006.
Working Paper FM/7	<i>Report on Fires in the Baltic Region and adjacent countries.</i> Ilkka Vanha-Majamaa. March 2006.
Working Paper FM/8	<i>Report on Fires in the Mediterranean Region.</i> A.P. Dimitrakopoulos and I.D. Mitsopoulos. March 2006.
Working Paper FM/9	<i>Report on Fires in the Sub-Saharan Africa (SSA) Region.</i> Alexander Held. March 2006.
Working Paper FM/10	<i>Report on Fires in the South East Asian Region.</i> B.J. Shields, R.W. Smith and D. Ganz. March 2006.
Working Paper FM/11	<i>Report on Fires in the Balkan Region.</i> Nikola Nikolov. March 2006.
Working Paper FM/12	<i>Report on Fires in the Caribbean and Mesoamerican Regions.</i> A.M.J. Robbins. March 2006.
Working Paper FM/13	<i>Report on Fires in the Australasian Region.</i> P.F. Moore. March 2006.
Working Paper FM/14	<i>Report on Fires in the South Asian Region.</i> A.M. Benndorf and J.G. Goldammer. March 2006.
Working Paper FM/15	<i>Report on Fires in the North American Region.</i> R. Martínez, B.J. Stocks and D. Truesdale. March 2006.
Working Paper FM/16	<i>Report on Fires in the Central Asian Region and adjacent countries.</i> Johann G. Goldammer. March 2006.